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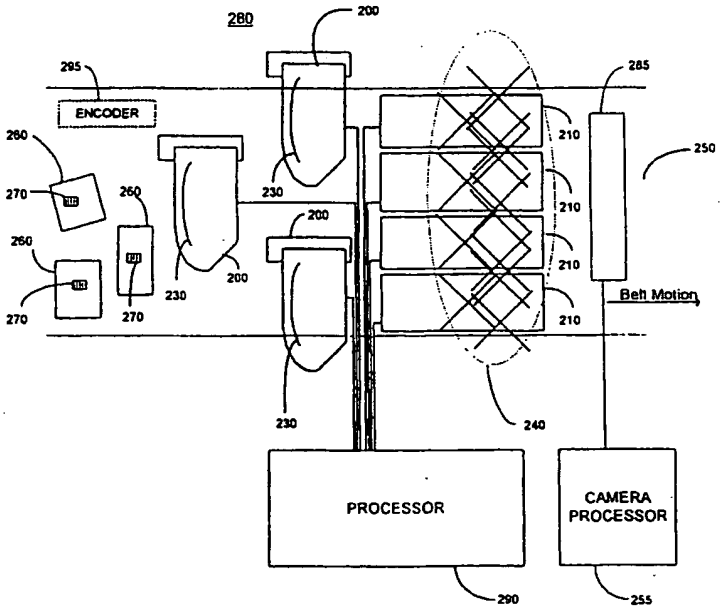


(57) Abstract

An information system for storing, retrieving, processing and displaying information captured about objects passing an information capture system. The captured and processed object information may include, for example, a visual representation of the object, a height representation of the object, an identification code from the object, dimensional information about the object, chemical signature information from the object, temperature information, date and time information, and a three dimensional model of the object. The various types of information can be accessed by users via a software interface.

SYSTEM AND METHOD FOR DIMENSIONING OBJECTS

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority from United States Provisional Application No. 60/128,079, filed April 7, 1999, and United States Provisional Application No. 60/151,620, filed August 31, 1999, which are expressly incorporated herein by reference.

BACKGROUND OF THE INVENTION

A. Field of the Invention

The present invention relates to systems and methods for determining the dimensions of an object.

B. Description of Related Art

In systems that operate on large numbers of objects, it has been known to use imaging devices connected to a computer systems to automatically determine the characteristics of the objects. Uses of such systems include quality assurance visual inspection systems. In the manufacturing industry such systems are utilized to detect defects in the items being produced. The use of the automated defect detection systems compares the products being scanned against the desired characteristics to determine if the items being produced fall within allowable tolerances.

Another industry where such automated object characterization systems have become known is the package shipping industry. Packages are provided, for example, with bar codes, wherein various types of bar code scanners are used to read the bar code applied to a parcel. By decoding the information provided in the bar code, a computer connected to the bar code reader can determine, for example, the address to which the parcel is to be shipped. Such information can be used, for example, to route the package to the proper destination.

System have also been used to determine the dimensional weight of packages being shipped. Traditionally, shipping charges were determined based on the weight of a package handled by a shipper. The determination of shipping rates based solely on weight, however, leads to inefficiencies

moving along an object transport system and includes an object dimensioning system for producing object dimension information for the objects, an object identification system for producing object identification information for the objects, and an image capture system for producing electronic images of the objects.

In a second embodiment of the invention an inter-facility system for capturing, storing, and accessing object information obtained from at least two object processing facilities is described and includes at least one object information capture system located at each facility for capturing information about objects being processed, a server located at each facility for storing the information about the objects being processed at that facility, an index server for identifying the facility at which the information associated with each object is stored.

In a third embodiment of the invention a method of recovering revenue based on dimensional weight is described as including steps of capturing information about the shape of an object, processing the captured information to provide a three dimensional model of the of the object, calculating a dimensional confidence value based on the three dimensional model of the object, capturing an image of the object, displaying, if the dimensional confidence value is below a threshold value, the model of the object and the image of the object to a human operator to confirm the fit of the model to the object, and accepting the three dimensional model or not based on an indication from the human operator.

It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate the invention and together with the description, serve to explain the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram of an exemplary parcel information capture system.

Fig. 1 shows an exemplary parcel information capture system 180 in accordance with a first aspect of the present invention.

Parcel information capture system 180 captures information about objects passing along belt 250. The information captured for each object may include the weight of the object, information encoded in a bar code on the object, the position of the bar code on the object, the position of the object on belt 250, an image of the object, and the dimensions of the object. In a preferred embodiment, weight information is obtained at a station other than the parcel information capture system. However, a scale operable while an object is in motion past the parcel information capture system 180 may be incorporated into the system in order to collect weight information.

In the embodiment shown in Fig. 1, the parcel information capture system 180 incorporates a belt position system 100, an object dimensioning system 110, a bar code capture system 120, an image capture system 130, and a processor 140. The relative positions of the information capture systems is exemplary only. The positions of the systems can be provided in any order along belt 250. Further, while parcel information capture system 180 is shown with a single processor 140, it is understood that more than one processor may be used to provide processing capabilities to the various systems. Further, the individual data capture systems may incorporate their own processors.

The belt position system 100 provides belt position information to processor 140. The belt position information is used to determine a position along the belt 250. Such indication can be provided in the form of, for example, a specific x-position or a pulse indicating an incremental increase in position since the last pulse. The position information provided by belt position system 100 may also include information about the time at which the position information was captured. In a preferred embodiment processor 140 associates a time value with the position information from belt position system 100. Information determinable from the position information includes belt velocity and belt acceleration information. By determining belt position values for discrete points in time, processor 140 can accurately determine the

In a preferred embodiment, three dimensional models of each of the objects on the belt are created.

Parcel information capture system 180 also includes a bar code capture system. Because the bar code on an object being scanned may be in any orientation about the object, the system operates using a plurality of bar code reading laser beams that are scanned across the object in different orientations relative to the object. The information from the dimensioning system, if collected prior to the use of the bar code capture system, can be used to focus the bar code capture system at the proper distance. In the preferred embodiment, the bar code capture system 120 is, therefore, provided down belt from the object dimensioning system 110.

Further, if the position across the belt of the object is determined by the object dimensioning system 110, the different bar code readers can be separately focused in order to provide proper scanning depth for simultaneously scanning different objects having different heights simultaneously passing the bar code readers. Further, by determining the orientation of a scanning beam that scans a bar code on an object passing the bar code capture system 120, the position in space of the bar code relative to the source of the beam can be determined. Specifically, the beam produced by the bar code scanner travels a specific known angular trajectory in space. By determining the time at which the bar code scanner scanned a bar code, the portion of the beam trajectory encompassed by the bar code can be determined. This information can be combined with the information captured by the object dimensioning system 110, *i.e.*, the bar code scanning beam subtended a determinable angular position in space relative to the bar code scanner. The angular position can be mapped onto the three dimensional model of the objects moving across the belt by correcting for the difference in time using the known change in position of the belt 250 during the time between the capture of the dimensional information and the capture of the bar code information. By combining the determined angular position in space from the bar code information with the three dimensional model

other gathered information so that the dimension information, bar code information, and image information determined from a specific object can be associated together.

A presently preferred embodiment of the parcel information capture system 180 of Fig. 1 is shown as parcel information capture system 280 in Fig. 2. Parcel information capture system 280 is shown as incorporating vertical dimensioning scanners 200 projecting dimensioning scanning beam patterns 230, bar code scanners 210 projecting bar code scanning beam patterns 240, belt 250, parcels 260 having bar codes 270 thereon, camera 285, object information processor 290, camera processor 255, and encoder 295.

Encoder 295 is used to correctly determine position along conveyor belt 250. Using the captured position of the belt at a specific time, and correlating that position with a time stamp value associated with the capture of information from an object, the time stamp value can be used to provide a correlation between the object and information captured about the object. The motion of belt 250 is measured using the encoder 295, which is, for example, a shaft encoder connected to a roller (not shown) on conveyor belt 250. When belt 250 moves the roller turns and shaft encoder 295 turns with it. For each small angle of motion in shaft encoder 295 an electrical pulse is produced. This electrical pulse can be sent, for example, to object information processor 290 to determine the position of the belt at a given time. The position determination is made by, for example, counting the number of pulses received. The number of pulses is translated into distance using a known translation between distance and rotational motion of the shaft connected to the encoder. By querying a position determining process within object information processor 290 at a given time, the position value of the belt at that time can be determined.

The dimensioning system is shown in the embodiment of Fig. 2 as three vertical dimensioning scanners 200 located above belt 250. The number of scanners provided is determined in view of the requirement that the entire width of belt 250 is preferably scanned by the combined action of

200 over time, height information of all objects on the belt can be captured and added to a height image of belt 250 and the objects thereon.

The raw height information received by vertical dimensioning scanners is preferably simplified by providing data concerning the outline of the parcel. Specifically, the data corresponding to the top of a flat rectangular parcel would incorporate a great number of height information points from the top surface of the object. Where different points are of similar height, they may be incorporated together into a line. Instead of being characterized by a plurality of points, the line is characterized by the three dimensional coordinates of its end points.

Further, lines at similar heights may be incorporated into a surface that characterizes that portion of the top surface of the object being scanned. The surface may be characterized by the lines that make up the border of the surface, such that, for example, a rectangular parcel can be represented by the four three-dimensional point coordinates of the corners of the top surface. A circular parcel could be modeled as a circle having a specific radius. The more complicated the shape the more point coordinates are required to model the top surface of the object. The use of three dimensional points provides information about the position of the object in space.

Further, using the information about the top surface of an object, the information can be fitted to models of objects stored in memory. For example, a model of a tire would be, for example, an outer circle with an inner circle centered within the outer circle. Using the model as the basis, the system can determine how well the object fits the definition of the model. For example, a model of a rectangular parcel requires that the top surface is comprised of four straight lines. If the lines that make up of the top surface are not straight, upon fitting the model to the shape, object information processor 290 can determine the deviation of the shape from the closest model shape, called the model fit. A geometric or statistical interpretation of the data may also be performed.

Fig. 4 illustrates intensity-coded images of parcels and height contour data. These images incorporate the information provided by the three vertical

Further, by associating the time of capture of the information with the position information provided by belt position system 100, object information processor 290 can determine the position along the belt at which the bar code was located at the time of capture. The translation of this information into the time frame of the dimensional information provided by the dimensioning system can be used to associate the bar code information with the proper dimensional information of parcel 260.

The preferred parcel information capture system 280 further includes an image capture system 150. Image capture system 130 of Fig. 1 is shown in Fig. 2 as a camera 285. The term "camera" is intended to encompass all systems capable of providing an analog or digital signal representative of objects within the field of view of the imaging device. For analog cameras, the analog signal may be translated into a digital signal as part of the processing of the signal. In a preferred embodiment the camera is a digital camera operating using an array of charged coupled devices (CCDs). The array of charge coupled devices is either a linear array encompassing the width of the belt or a two dimensional array capable of imaging the width of the belt. Alternatively, separate cameras may be employed to ensure full coverage of the width of the belt surface.

In a preferred implementation, the image information acquired by camera 285 is provided to camera processor 255, which processes the image information provided by camera 285. The processing may include adding a time stamp to the image and/or translating the image into another format. In a preferred implementation, camera processor 255 translates the image into a compressed image format such as JPEG. Using the time stamp information the image information can be associated with positional information along the belt as provided by encoder 295. Preferably camera 285 is provided looking downward at the belt at an angle in order to provide a view encompassing the top and at least one side surface of the objects passing through parcel information capture system 280.

In a preferred embodiment, camera 285 employs a two dimensional array of charged coupled device elements to provide time stamped images of

A number of different types of information, therefore, are available about object that pass a parcel information capture system 280. Because each parcel has a specific identification code provided by a bar code or other identifier placed on the parcel, all of this information can be electronically associated together with the parcel identifying code as the associating information. All of the information is identifiable by the parcel identification code associated with each parcel.

Fig. 7 is a diagram of a basic system configuration for a single-facility server system 700. The term "facility" is intended to encompass parcel processing facilities such as parcel sorting facilities. Server system 700 includes a server 730 connected to a database 735, a camera processor 255, an object information processor 290, a local area network 720, and a user terminal 710.

Camera processor 255 and object information processor 290 are as described above with respect to Fig. 2. The time stamped data processed by object information processor 290 and camera processor 255 is transmitted over network 720 to a server 730. Network 720 is shown as a local area network (LAN). However, a wide area network (WAN) or other network configuration may also be used. Server 730 stores the information in memory, shown as a database 735. In a preferred embodiment, an object information client application running on object information processor 290 forwards the time-stamped information over network 720 to a object information server application running on server 730. The object information server application stores the data in database 735 using the time stamp and a parcel identifier, such as the bar code read from the parcel, as identifiers of the captured information. Similarly, an image capture client application running on camera processor 255 forwards the time stamped image information over network 720 to an image capture server application running on server 730. The image capture server application stores the data in database 735 using the time stamp identification information. Using the time stamp applied to both sets of information, and calibrating for any time

940. Specifically, a user attempting to locate information about a specific parcel will not necessarily know which facility 940 through which the parcel was processed. The index master database stores data corresponding to each parcel processed by the multiple parcel information capture systems 280. The information may include a parcel identification number such as a bar code or tracking number, the data and time that the information was captured, and a code identifying which parcel information capture system 280 captured the information. The index master database may also store information about a third party associated with the parcel, such as the party who shipped the parcel or the party who is to receive the parcel. When a user requests information via a user terminal 710 about a specific object, the request is received by server 910, which runs a search against the index master database 920 to determine which database 735 contains the record-specific information. The server 910 returns the results of the request to the user terminal 710, which then sends a request to the specific server 730 having access to the information stored in the database 735. Server 730 accesses the requested information and forwards it to user terminal 710. The steps required to access the information are transparent to the user after the object specific query has been initiated.

Two basic data access paradigms are available to user terminal 710, "pull" and "push."

The process of pushing data to the user is provided by a "push" process application running on server 730. As the information provided by object information processor 290 and/or camera processor 255 is provided to server 730, the push process application analyzes the data to determine if the attributes assigned to a given object meet predefined object characteristics. If the attributes meet the predefined object characteristics, the information acquired about the object is automatically forwarded to a user terminal 710.

The push process may be used, for example, to capture incremental dimensional revenue by improving the ability of the system to determine the proper dimensional weight of objects being processed. Parcel information capture systems 280 operating to determine dimensional information about

for example, be reviewed by server 730 as they are being stored in database 735, and those records having a dimensional confidence below the level beyond which the dimensional information would otherwise not be applied will be pushed to a user located at a user terminal 710.

Fig. 10 is an exemplary software interface 1000 for use in collecting incremental dimensional revenue. The interface provides two separate data streams, an image browser 1010 which provides image information from a database 735, a virtual reality modeling language browser 1020, and a control and information panel 1030. The image browser 1010 allows the user to examine images of the parcels. The images are advance using a scrolling bar 1035. There is also a separate option where the images are streamed continuously to the user to provide an image of the objects moving along belt 250 over time.

The virtual reality modeling language browser 1020 displays a virtual landscape encompassing belt 250 and any objects on belt 250. The virtual landscape is compiled using the dimensional data produced by the vertical height scanners 200 of the parcel information capture systems 280. The user is given the option via view selector 1055 of control and information panel 1030 to manipulate the image by selecting different viewing angles for the virtual landscape. The angles are shown as, for example, top, back, left, right, and camera. The "camera" angle simulates the same view of belt 250 that is provided by the image browser. Using scrolling bars 1035 and 1045, the user is able to advance the parcel landscape in either direction. The control and information panel 1030 also supplies the dimensional confidence value 1040 and parcel identification code 1050 (shown as a tracking number) assigned to the parcel in question. The parcel may be identified in the virtual reality modeling language browser 1020 by, for example, displaying that parcel in a different color. The dimensional confidence value shown is 87%.

A number of options may be given to the user to alter the data. The user may be given the option to split the parcel, *i.e.*, to chose a position to segment an object that was perceived by the parcel information capture system to be a single object when in fact two separate objects were present.

displayed to the user will be the information from the current date and time for the selected parcel information capture system 280. As shown in Fig. 11, the user is given the option to stop the flow of images, reverse the flow of images, or restart the flow of images.

An alternative use the pull type of data access would be, for example, customer service, operations sort control, lost parcel attribute identification, and security and surveillance of package handling . The user supplies information about the object through a query and application driven object information is returned. Fig. 12 shows an exemplary software interface 1200 for use when locating a parcel based on a parcel identification number, *e.g.*, bar code or tracking number. Many of the same options provided by interface 1000 are provided to users of interface 1200. The user inputs, for example, a parcel identification number into search field 1230 to start the search process. The system provides side by side views of image information in image browser 1210 provided by the camera processor 255 as the parcel passed camera 285 and a three dimensional model of the belt 250 and objects on belt 250 in virtual reality modeling browser 1220 as the parcel passed the dimensioning system. The default view provided in the modeling browser 1220 is the same perspective view as from camera 285. The user also has the option to change the perspective viewing angle of the three dimensional model to, for example, the opposite angle from the camera position (back), the right side, the left side, or a top view using view selector 1255. For situations where the viewing angle would result in the obscuring of objects because they are behind other objects, semitransparent viewing of the three dimensional modeled objects can be provided. The object in question can be shown by modeling browser 1220, for example, in a different color from other objects. Interface 1200 provides information about the object in shipment information window 1250.

It will be apparent to those skilled in the art that various modifications and variations can be made in the field of parcel information acquisition of the present invention and in construction of this parcel information system without departing from the scope or spirit of the invention.

WHAT IS CLAIMED IS:

1. A system for capturing information about objects moving relative to the system comprising:

an object dimensioning system for producing object dimension information for the objects;

an object identification system for producing object identification information for the objects; and

an image capture system for producing electronic images of the objects.

2. The system of claim 1, wherein the objects are parcels.

3. The system of claim 1, wherein the object dimension information, object identification information, and electronic images each have time stamp information associated therewith.

4. The system of claim 3, wherein object dimension information, object identification information, and electronic images of an object are correlatable based on the time stamp information.

5. The system of claim 1, wherein the object identification system comprises at least one bar code scanner.

6. The system of claim 5, wherein object dimension information associated with an object is correlated to object identification information associated with the same object using information about a scan pattern produced by the bar code scanner and time stamp information.

7. The system of claim 1, wherein the object dimensioning system comprises at least one vertical height scanner.

8. An intra-facility system for capturing, storing, and accessing object information comprising:

one or more object information capture systems for capturing information about objects being processed;

a server for storing and accessing the object information from the one or more object information capture systems; and

one or more user terminals for requesting specific object information from the server;

displaying, if the dimensional confidence value is below a threshold value, the model of the object and the image of the object to a human operator;

allowing the human operator to adjust the data corresponding to the three dimensional model; and

applying the adjusted model as a new dimensional model of the object.

13. The method of claim 12, wherein the three-dimensional model is used to determine a dimensional weight of the object.

14. The method of claim 12, wherein the adjustment to the three dimensional model includes splitting a model of an object that encompasses multiple objects into data reflecting the multiple objects.

15. The method of claim 12, wherein the adjustment to the three dimensional model includes permitting the human operator to edit the data corresponding to the three dimensional data.

16. A computer program for determining dimensions of an object, the program performing a method comprising:

capturing information about the shape of the object;

processing the captured information to provide a three dimensional model of the of the object;

calculating a dimensional confidence value based on the three dimensional model of the object;

capturing an image of the object;

displaying, if the dimensional confidence value is below a threshold value, the model of the object and the image of the object to a human operator to confirm the fit of the model to the object; and

accepting the three dimensional model or not based on an indication from the human operator.

17. A computer program for determining dimensions of an object, the computer program performing a method comprising:

capturing information about the shape of the object;

processing the captured information to provide a three dimensional model of the of the object;

capturing information about the dimensions of the object;

processing the captured information to provide a three dimensional model of the of the object;

calculating a dimensional confidence value based on the three dimensional model of the object;

capturing an image of the object;

displaying, if the dimensional confidence value is below a threshold value, the model of the object and the image of the object to a human operator;

allowing the human operator to adjust the data corresponding to the three dimensional model; and

applying the adjusted model as a new dimensional model of the object.

22. The computer readable medium of claim 21, wherein the adjustment to the three dimensional model includes splitting a model of an object that encompasses multiple objects into data reflecting the multiple objects.

23. The computer readable medium of claim 21, wherein the adjustment to the three dimensional model includes permitting the human operator to edit the data corresponding to the three dimensional data.

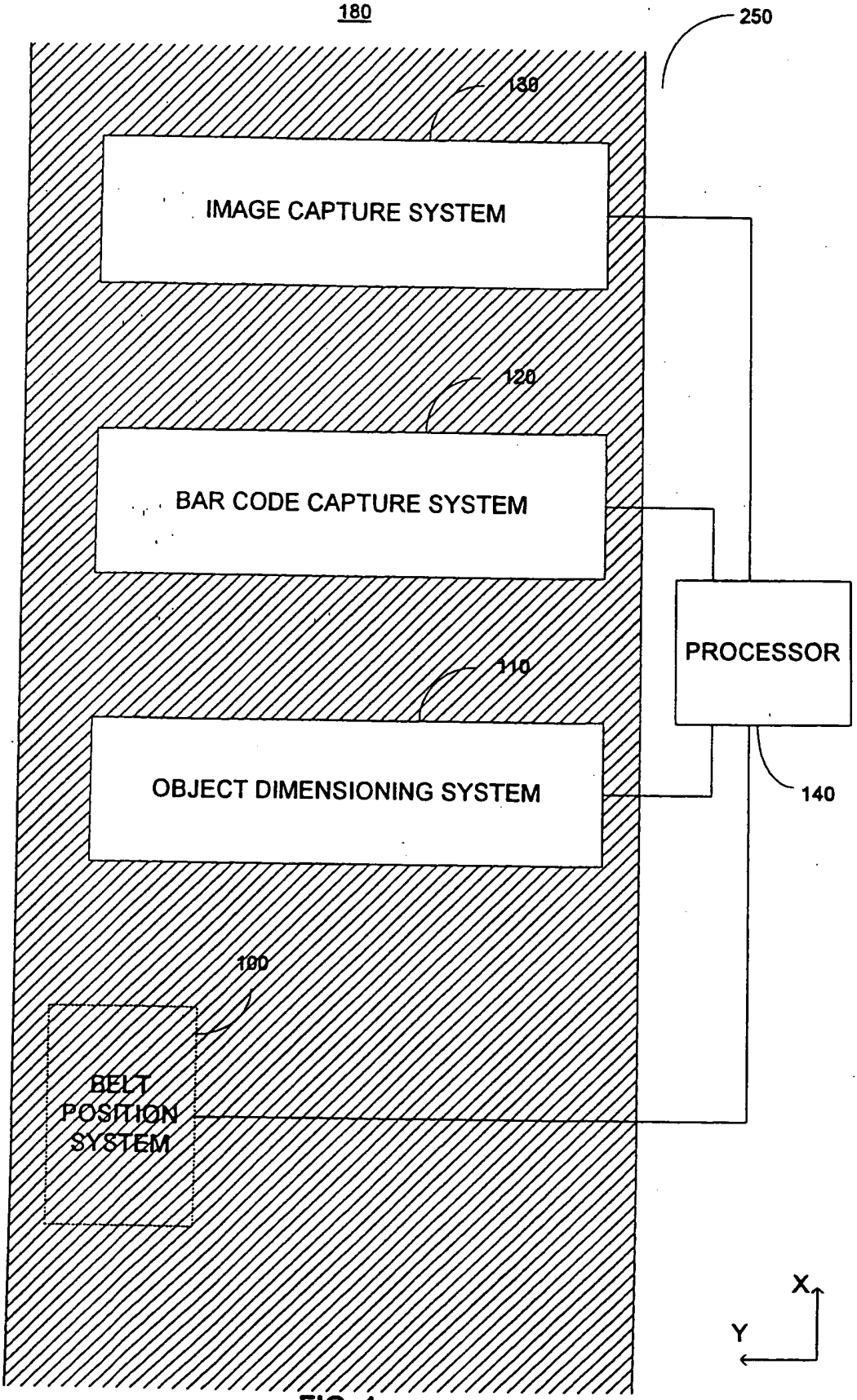
24. A user interface for providing information about an object to a user, the interface comprising:

an image section for providing an image of the object; and

a virtual reality modeling section for providing a three dimensional model of the object based on dimensional information captured about the object.

25. The user interface of claim 24, wherein the virtual reality modeling section provides a selectable interface for selecting different views of the three dimensional model.

26. The user interface of claim 24, further comprising an object identifier section for providing an object identifier for the object.


180
250
130
IMAGE CAPTURE SYSTEM
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BAR CODE CAPTURE SYSTEM
110
OBJECT DIMENSIONING SYSTEM
PROCESSOR
140
100
BELT POSITION SYSTEM
X
Y

FIG. 1

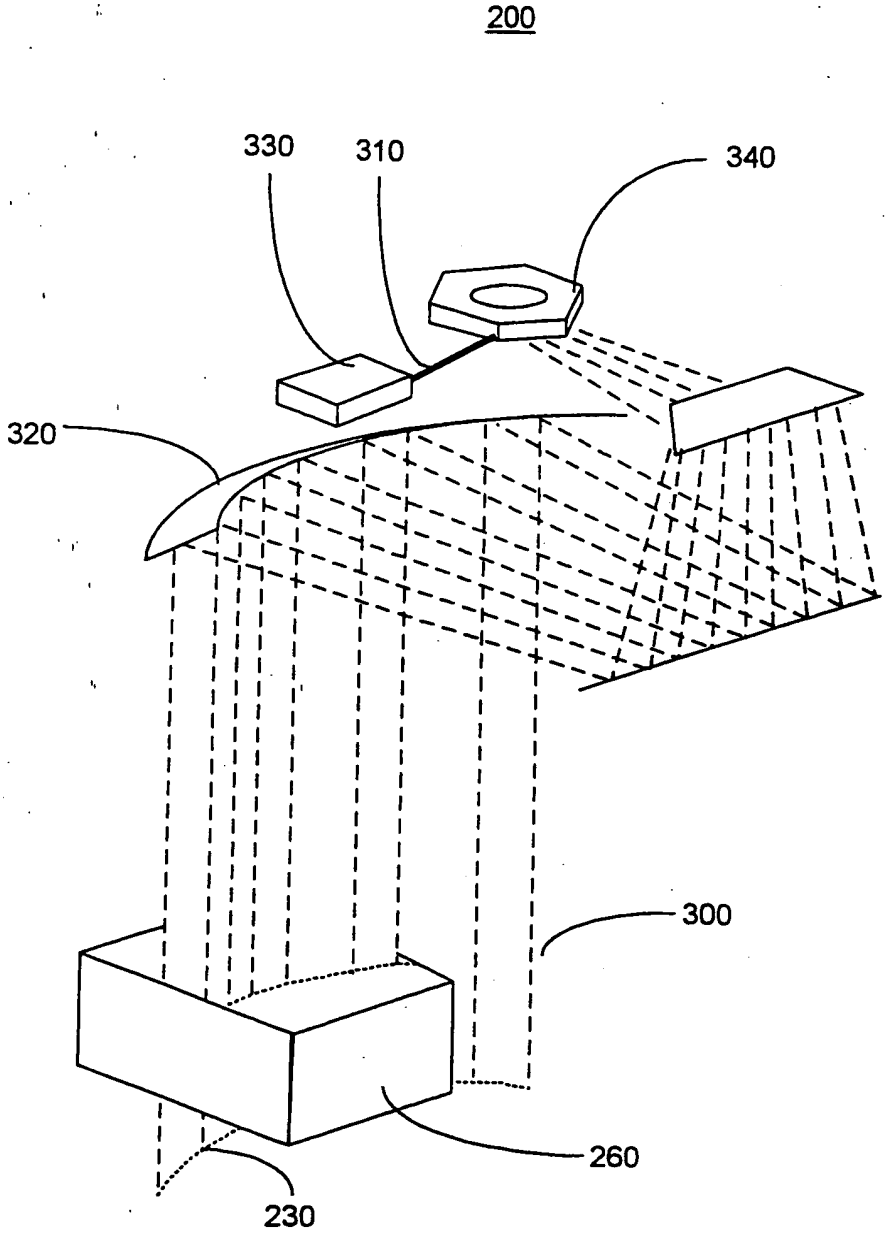


FIG. 3

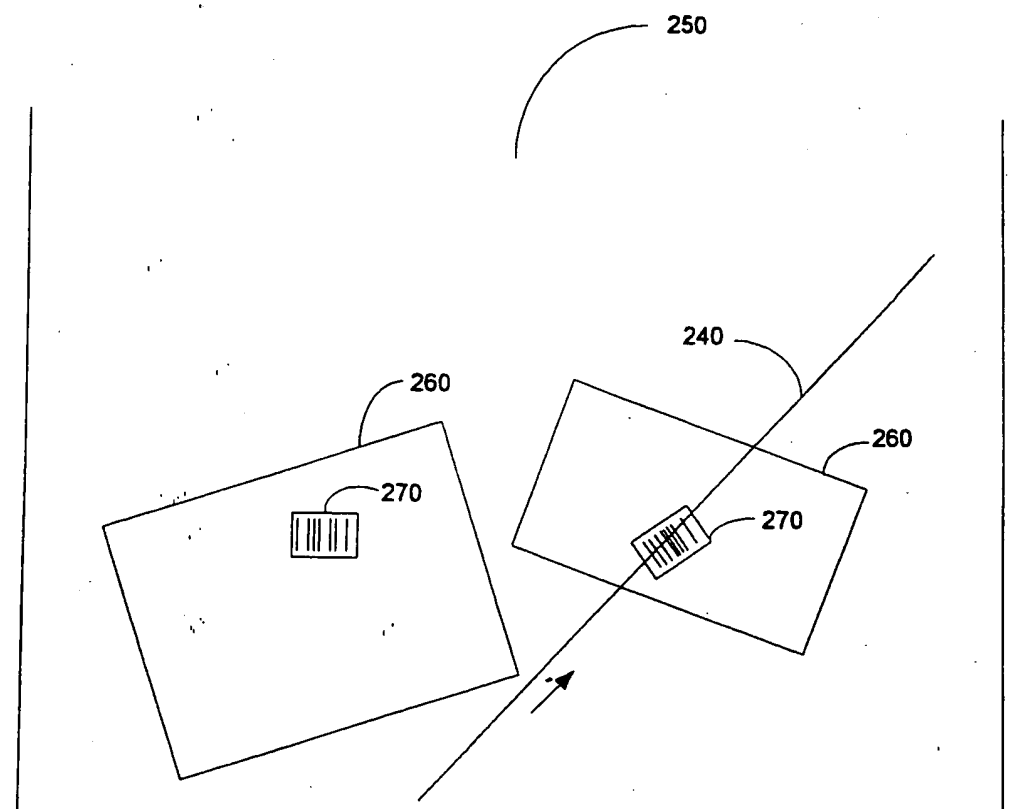
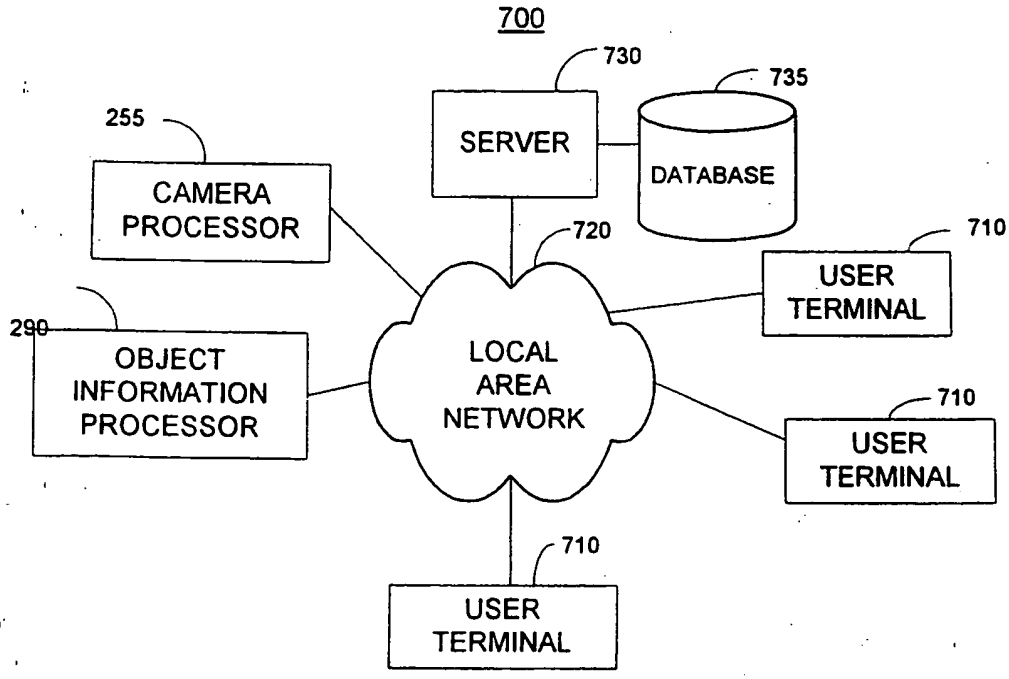


FIG. 5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USER TERMINAL

FIG. 7

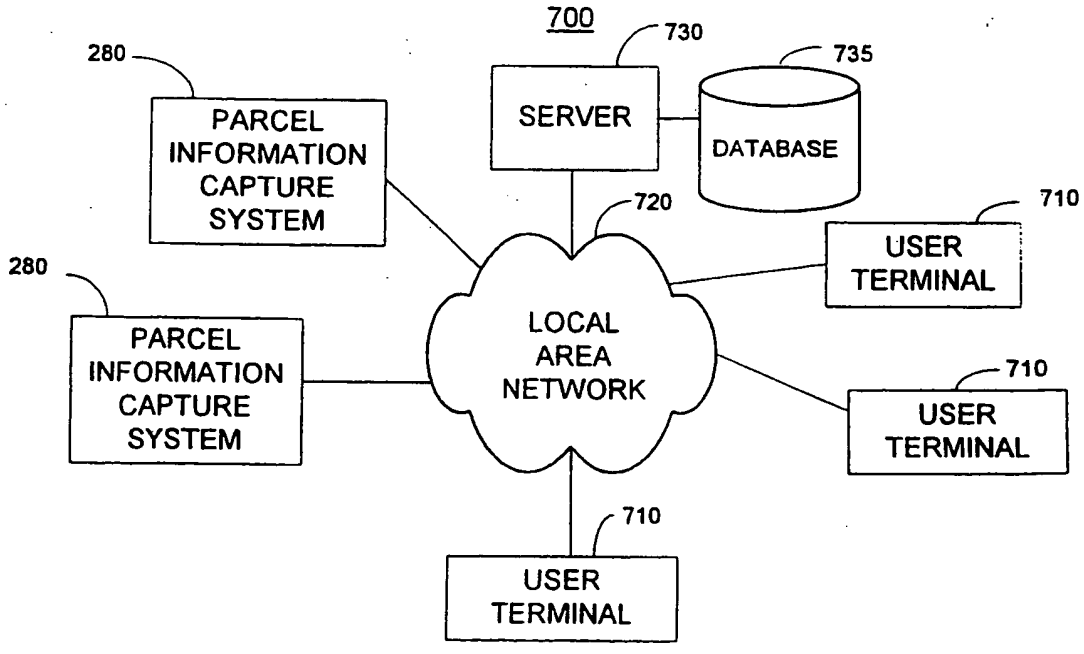
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FIG. 8

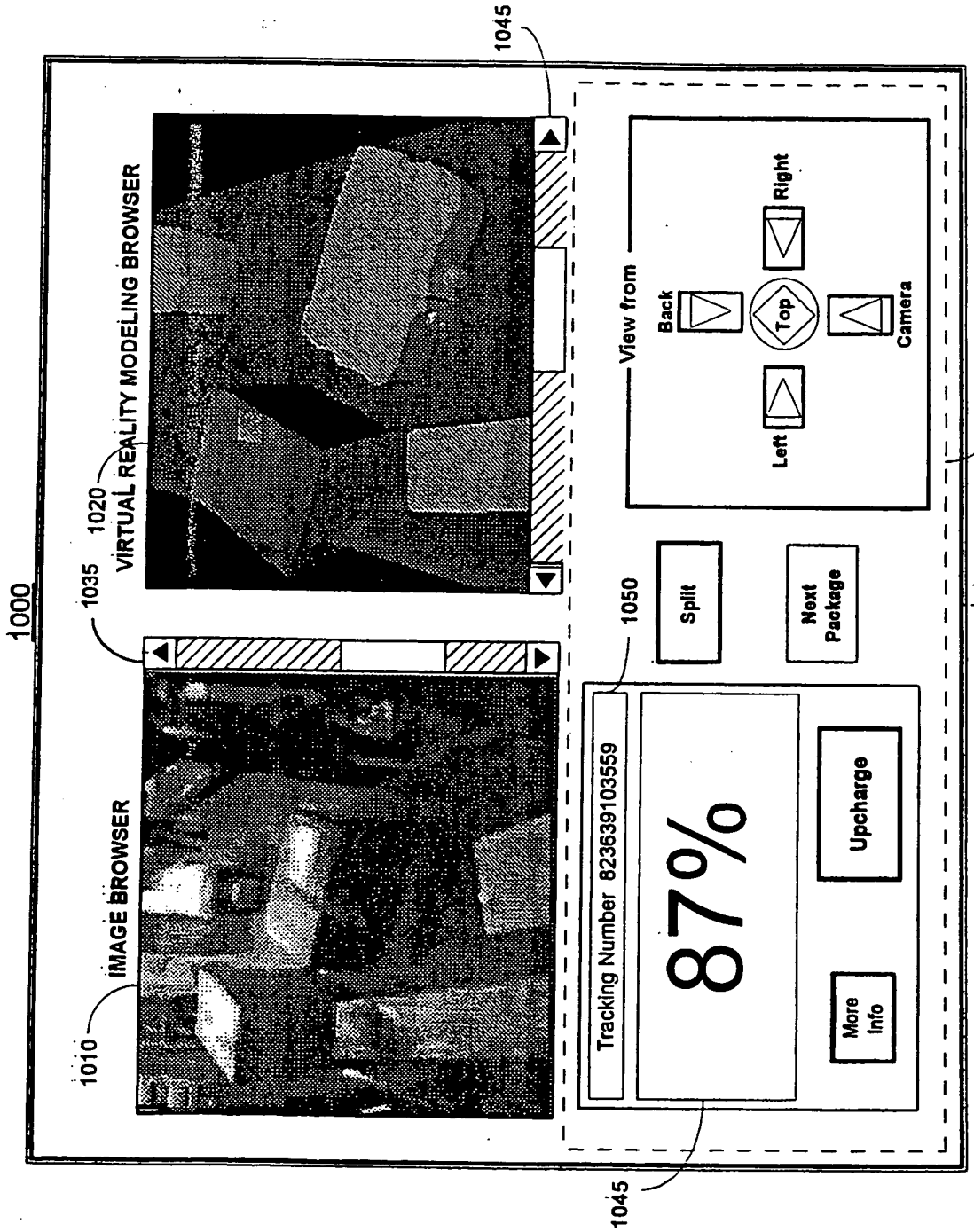
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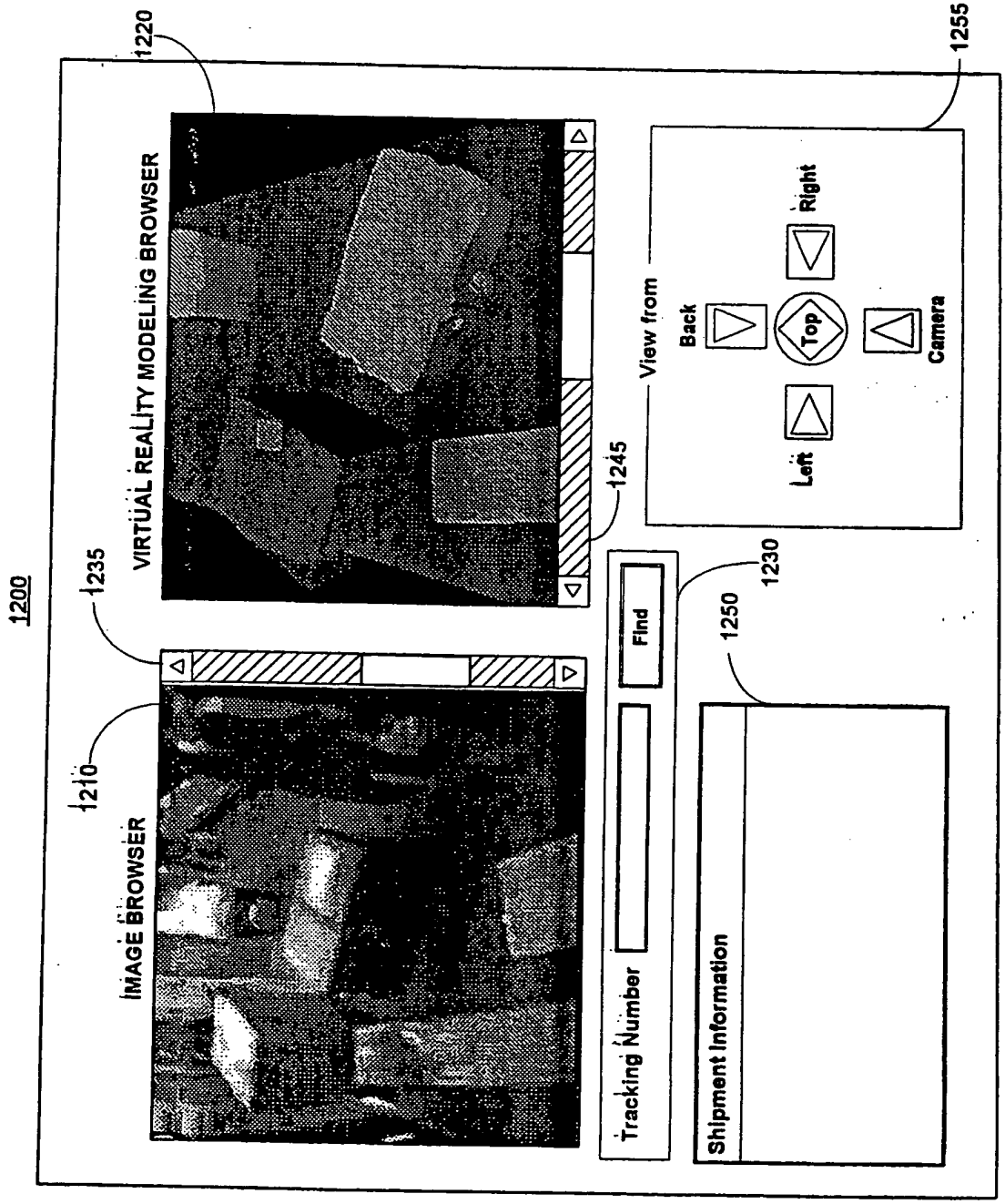
FIG. 10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Shipment Information
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Right
Left
Camera

FIG. 12

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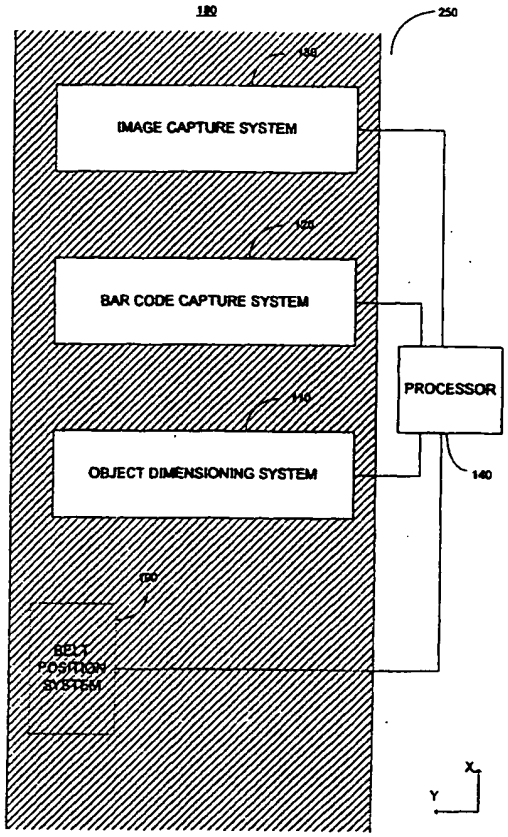
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW.

[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR DIMENSIONING OBJECTS



(57) Abstract: An information system for storing, retrieving, processing and displaying information captured about objects passing an information capture system. The captured and processed object information may include, for example, a visual representation of the object, a height representation of the object, an identification code from the object, dimensional information about the object, chemical signature information from the object, temperature information, date and time information, and a three dimensional model of the object. The various types of information can be accessed by users via a software interface.

WO 00/59648 A3

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 00/08975

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B07C5/04 B07C5/34 B07C5/342 G06T17/40 G06F17/30

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B07C G08G G06T G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 582 964 A (SIEMENS AG) 16 February 1994 (1994-02-16) column 2, line 5 -column 4, line 11 figures 1,2	1,2,5,7
Y	---	3
Y	DE 197 38 849 C (CCD WEBER GMBH) 5 November 1998 (1998-11-05) column 1, line 3 -column 2, line 34 claims 1-3 figure 1	3

X	US 5 253 302 A (MASSEN ROBERT) 12 October 1993 (1993-10-12) column 3, line 23 -column 4, line 44 figure 1	1,5,7

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 July 2000	16. 11. 2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	De Ronde, J

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Form PCT/ISA/210 (second sheet) (July 1992)

ENSDOCID: <WO_____0059648A3_I_>

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 00/08975

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-7

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/US 00/08975

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